EFFICIENCY ASSESSMENT REPORT

CE GREEN CITY PANELS

A recycled rubber-based panel developed for water retention in creating greenroofs, locally produced from local waste

Solution ID: 14455
Company: CEYES Circular Experts
Country: Netherlands
Export Date: 01.11.2022

ASSESSMENT RESULTS

APPROVED

FEASIBILITY

- Credibility of concept	YES
- Scalability	YES

ENVIRONMENT

- Environmental benefits	YES

PROFITABILITY

- Client's economic incentive	YES
- Seller's profitability	YES

GENERAL COMMENTS FROM THE SOLAR IMPULSE FOUNDATION

The Solution is awarded the Solar Impulse Efficient Solution as:

- **It is fully satisfying the Eligibility Criteria** in terms of: (1) Nature of the Solution namely, physical/financial product, technology, industrial process, or service; (2) Ownership by a Member of the World Alliance for Efficient Solutions; (3) Contribution to at least one of the Sustainable Development Goals (SDGs), namely SDG 6, SDG 7, SDG 9, SDG 11, SDG 12; (4) Minimum maturity level, namely "prototype testing 1:1 in lab" (TRL 6 -7);
- **It is operating in accordance with the Solar Impulse Foundation's ethical position** as expressed by the Membership Agreement;
- **It is compliant with the conditions expressed in the "Liability Waiver Declaration"** signed by the Member in the framework of the labeling process and external reputational check;
- **It has been reviewed and pre-validated** by the Solar Impulse Foundation's team during the pre-screening stage, to ensure minimum standard of quality, in terms of relevance and completeness of the information provided in the application form;
- **It has been assigned and evaluated** according to the official "Label Standards" by three independent Experts with at least five years of Experience in one of the sectors of application of the Solution;
- **It has been assessed and formally validated (accepted)** by three External independent Experts based on the five criteria (credibility of concept, scalability, environmental benefits, client's economic incentive, seller's profitability). In particular, the three independent Experts performed valid assessments, thus provided complete and coherent answers in accordance to the official "Label Standards" and "Assessment Guidelines".
- **It received a minimum of two "YES" answers** from two different Experts on all five criteria, meaning that all the five criteria were satisfied and obtained a majority of "YES". As a result, the Solution does meet the requirements for being awarded the Solar Impulse Efficient Solution Label.

It is important to notice that, the outcome is attributed to the Solution itself and NOT to the entity submitting the Solution (the company).

FEASIBILITY

The Feasibility section is aimed at determining the technical viability of the idea behind the Solution, such as ensuring a Solution is feasible in the real world.
This section is composed of two criteria and it considers: the technical requirements of the proposed Solution and captures its ability to be credible based on a resilient technology or concept (**Criterion 1**) and its potential to be technically scaled up and deployed in the real world (vs. in a laboratory environment) without additional constraints (**Criterion 2**).

EXPERTS REVIEWS

CRITERION 1 - CREDIBILITY OF CONCEPT

Can the technology behind the Solution be constructed and operated as designed?

> **YES**
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> **First Expert justification -** The Solution is a recycled rubber panel made of used tires for creating greenroofs. The production of the panels uses a special molding presses with a force of 96 tons at 150 bars - the molds are heated up to 100 degC. The top of the panels contains square reservoirs that hold the water, whereas the bottom is equipped with channels for draining. The detention panels have been developed for the delayed passage of 1 mm of water per hour so that even under extreme rainy weather conditions the roof continues to buffer water and drain in a controlled manner.

> **YES**
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> **Second Expert justification -** The solution is similar to others which have already a specific market space in the building sector. The construction is based on recycling process and it can benefit from different flows of waste material. The solution can find different application in the building sector both private and public. It can operate efficiently if it is specifically design for public outdoor spaces (public spaces, playgrounds...)

> **YES**
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> **Third Expert justification -** The CE Green City universal panels are produced from recycled rubber granules of the tires, press molded at 100 oC with a force of 96 tons at 150 bars, resulting into 100% water resistant panels (30, 45, and 60 mm thickness). With a squared 20.35 l/m2 water reservoir on top, the panel's bottom drains and designed for roof vegetation mostly in dry countries. The CE Green City rubber universal panels meets the ISO 14040/44, ISO 14025, ISO 21930 and NEN 8006 (Environmental Efficiency Assessment Method for Buildings and Construction Works), and comply with the soil quality ordinance maximum emissions. This means that the panels can help to reduce the ambient noise level by 15 dB and contact noise by 23 dB at frost resistance of -30 degrees Celsius (with 75 years lifespan). Therefore the technology is credible for the fact that it even surpasses the standard pressing force of 24 tons/100Bar to 96 tons/150Bar. It is further well posed to increase the capacity of tire recycling from less than 10% currently, hence reduce the prospects of landfill disposal. It will further widens the marketability and usage of the crumb rubber.

CRITERION 2 – SCALABILITY

Is the manufacturing (if a product) or distribution (if a service) of the Solution at scale technically feasible?

> **YES**
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> **First Expert justification -** The use of the panels (= placement of production hubs CEYES HUB) are planned to be in areas of no more than 400 kilometers away from the production sites in order to be compliant with SDG11 "Sustainable Cities and Communities". Meaning the production of the panel and so the recycling of rubber waste should be in the same region where it was generated. Hence, the project says it is planned to organize production on the basis of hubs near million-plus cities (sourcing strategy). This is achievable as CEYES HUB is a compact production site with box equipment in containers, a mini-office and a finished product warehouse. 2.000 m2. With that in mind, scalability is feasible.

> **YES**
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> **Second Expert justification -** The solution has a simple and long lasting production system. It has chosen to empower last mile producer by selling "the way to build their product". It is a smart and reliable system which delegates most of inconvince to the last mile production spot. This option make the solution really scalable and accessible to multiple territories, economies and configuration of rules in buildings. The disribution will be way more sustainable than centralized productions.

> **YES**
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> **Third Expert justification -** Apart from the already growing market of green building materials at a rate of 9 % CAGR ($132.13 billion -2020-2024) (Technavio), the availability of raw materials from recycled tires globally makes a good case to scale up this innovation. The production of tires this year (2022) is expected to be over 500 thousand tons and this require end of life processing. The demand in green energy efficient buildings is growing at a fast rate due to the great awareness and policy changes towards climate neutrality processes and life sytles. This innovation produces the tiles that has a superior water holding capacity of 20.35 l/m2 as compared to the less than 15 l/m2 of the alternatives. Therefore this solution is very much likely to scale up.

Additional feedback / advice for the member

First Expert - Re scalability and commercial expansion, I would suggest you emphasise your links with regulators and how norms can impact the use of your product in various geographies and business contexts.

ENVIRONMENTAL IMPACT

The Environmental Impact section is aimed at determining the impact of the Solution at the different phases of its lifetime: production, transportation and distribution, as well as use and disposal phase.
This section is composed of one criterion and it considers: the potential to enable a direct positive impact (**Criterion 3**) on the environment compared to the mainstream alternative identified – referring to the scope of the following elements: Energy use, CO2 emissions, Water use/materials use, Air quality, Ecosystem preservation.

EXPERTS REVIEWS

CRITERION 3 - ENVIRONMENTAL BENEFITS

Can the Solution deliver an incremental environmental benefit versus a mainstream alternative, considering the lifecycle (production, use and disposal stages) of its value chain?

YES

First Expert justification - The solution provides a recycling option for used tyres. Additionnaly, the solution creates panels for water retention to create green rooftops. The raw material is locally sourced (radius of max 400Km between production site and rooftops = objective is to target large cities) = the Ceyes RPR retention panels will be locally manufactured at a "CEYES molding HUB" Green rooftops versus alternative option: comparison between various types of panels: the documents provided describe the environmental benefit in all phases, including the production phase. The total profit by using a green roof with CEYES panels instead of a standard roof amounts to a total of more than 4.5 kg CO 2-eq per m² annually. (assumption is that all raw material comes from recycled tyres). In addition,the extended lifespan of these panels can even enhance this positive impact. Additional benefits can be associated with better water management (rain harvesting). This shows that the solution delivers a positive environmental benefit.

YES

Second Expert justification - The solution has been deisgned to be more resistant than mainstream alternative. It has a longer life span than similar product for the building system. The production-distribution-end of life evalutation has a better foot print in c02 reduction, saving of new material estraction. As long as this produt is focusing on a versatile recycle material which has plenty of stock in many different areas, it is predictable to be the first of other products for the building construction.

YES

Third Expert justification - The global tire market is said to be selling 2,000 million tires per year as of 2020 and is expected to grow to more than 2,700 million tires by 2026 (https://rubberworld.com/global-tire-market-forecast-to-produce-over-2-7-billion-tires-by-2026/). However, only less than 10 % of this tires are properly recycled and the recycling market is divided by product category, end user, and rubber type. Additional categories for the end user segment include manufacturing, the automotive and aviation industries, construction, and others (sports, home decor). Due to the widespread use of recycled tires in the production of some auto parts and retreading in the aviation sector, the automotive and aviation sectors dominate the tire recycling business. However, due to the increasing use of rubberized asphalt as building materials, the construction sector is predicted to develop significantly during the projection period. Global tire recycling market is segmented on the basis of rubber type, product type and by end user. End user segment is further categorised into automotive & aviation sector, manufacturing, construction and others (sports, home decor). Automotive and aviation sector dominates the tire recycling market owing to the wide adoption of recycling tires in manufacturing some auto parts and retreading in aviation sector. However, construction sector is expected to witness remarkable growth during the forecast period owing to the rising application of rubberized asphalt as construction materials. Lack of adequate demand for recycled materials is impeding the production of recycled tires, claims Goldstein Research. The demand for recycled tires is being significantly impacted by uncertainty relating to the low quality of recycled tire materials. But the market for recycled tires is anticipated to grow thanks to creative implementation in a variety of applications. Nevertheless, the market for recycled tires is expected to develop steadily throughout the forecast period, reaching USD 1.12 billion by 2024. Therefore the Green City Panel solution is well staged to participate in this important environmental process. This innovation stands out

> in terms of saving the CO2 emissions. In the production phase, the innovation produces -0.241 kgCO2eq as compared to the alternative's 0.685 kgCO2eq. Overly, 27.93 % of CO2eq savings are registered on the basis of production, distribution and disposal. Other indirect environmental benefits such as the prolonged life span of a building, water management enhancement, particulate matter and health effects. The innovation has more environmental benefits than the alternative (green plastic based roofing panels).

Additional feedback / advice for the member

First Expert - Suggestion would be to detail how to structure a sourcing strategy, in the long term.

PROFITABILITY

The Profitability section is aimed at determining the capacity of a Solution to deliver an economic incentive for the client, as well as to generate profits for the seller in a short term. This section is composed of two criteria and it considers: The capacity of a Solution to deliver an economic incentive (direct, indirect, or hidden economic savings) for the client (**Criterion 4**) compared to the mainstream alternative and the capacity of the Solution to generate profits for the seller (**Criterion 5**) in the short term, regardless of the marketing strategy and the novelty of the product.

EXPERTS REVIEWS

CRITERION 4 - CLIENT'S ECONOMIC INCENTIVE

Is the total cost of ownership of the Solution lower (or same) compared to the mainstream alternative? Please evaluate this considering potential hidden benefits for society, and foreseeable regulatory changes within 5 years.

> **YES**
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> **First Expert justification -** The business model is like a franchise model. The customers of the innovator are purchasing the machinery that will produce and sell the panels in different regions. The simulations shared by the innovator show an estimated payback time at less than 2 years. CEYES says they will ensure that the licensee work will be carried out according to their standards, and will guide the entrepreneur in this. And with future several CEYES Hubs in one country or area, they says they will purchase together, which increases the volumes and allows to negotiate better prices. With that in mind, this business can be profitable for those who will set-up a company using this machinery.

> **YES**
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> **Second Expert justification -** The solution has similar price that main stream alternative but it can provide long lasting evident benefits for its clients . It is reliable that regulations arounf the world will make this product a priority choice in a public tender for public contruction projects. Its usage can anticipate safty issues in those warning areas with sudden storm and intense raining weather. In cities with water resisten urban fabric, this solution can be included in their forecasting civil protection plan (also for mantainance of private ares).

> **YES**
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> **Third Expert justification -** The business of the CEYES of selling machinery and own the patents of the products by making the buyer pay a liense fee makes the client become a partner and the posibilities of following the quality, financial and transfer some risks to the owner of the equipment. The maintenance of the equipment will lower the down time and efficiently ensure productivity. By creating the hubs for selling this products, more sales and market will be made available. The concepts consists of the recyclers, producers, sales and installers, casting the net wider for exchange of sales and demand information hence more sales for the client.

CRITERION 5 - SELLER'S PROFITABILITY

Could the Solution itself be profitable for the seller within 5 years, with a sale's price at which clients would buy it? Please evaluate this regardless of the marketing strategy and the novelty of the product.

> **YES**
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> **First Expert justification -** The Solution Provider has indicated that their Solution's commercialization stage has not yet reached the breakeven point. The turnover of the company comes from commissions from the sale of machinery and IP on the panels in the future. Not only do they sell the machines, the buyers will also pay a license fee to CEYES for each product produced. Green building material market will drive the need for this type of material. Market expansion should allow profitability by 2024, selling machineries in various geographies. With that in mind, the business can be profitable.

> YES
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> **Second Expert justification -** I think this product could be chosing to mainly working with prefabrication systems and those areas/enterprises already working on this in order to focus on a specific market, to optimize and be integrated with a specific established design. Moreover, this solution can become pro-active choice in many different public space designs, giving the seller a significat advantage in the production and mantainance services of public administrations.

> YES
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> **Third Expert justification -** The seller has indicated that they will reach the profitability stage in 2024 and from inception the turnover comes from commissions from the sales of machinery. With the estimated $238 billion global market of the Green Building Materials by 2020 and $425.4 billion by 2027, the seller is at peace with making money more so that policy and way of life changes are been promoted globally to avoid the effects of climate change. The market size in Russia is projected by 18 large cities (12.7 km2. Above this buyers will be paying license fees on all the products and quality conformity is assured. Therefore the innovation is profitable to the seller.